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ABSTRACT

Written for state- and local-level education policy makers, educators, political and consumer organizations, and representatives of business and industry, this document stresses the importance of energy education and ways to incorporate energy education into different curriculum structures. It does not attempt to provide specific answers or solutions to the many energy-related questions facing society, but suggests how these important issues can be approached in an objective learning environment. Section one provides background data on energy issues. Section two describes six fundamental objectives of energy education and provides a rationale for each. The last section identifies several guidelines for state and local action, stressing low-cost alternatives. The appendix lists selected sources of information that may be useful in developing and implementing energy education programs. (Author/DC)

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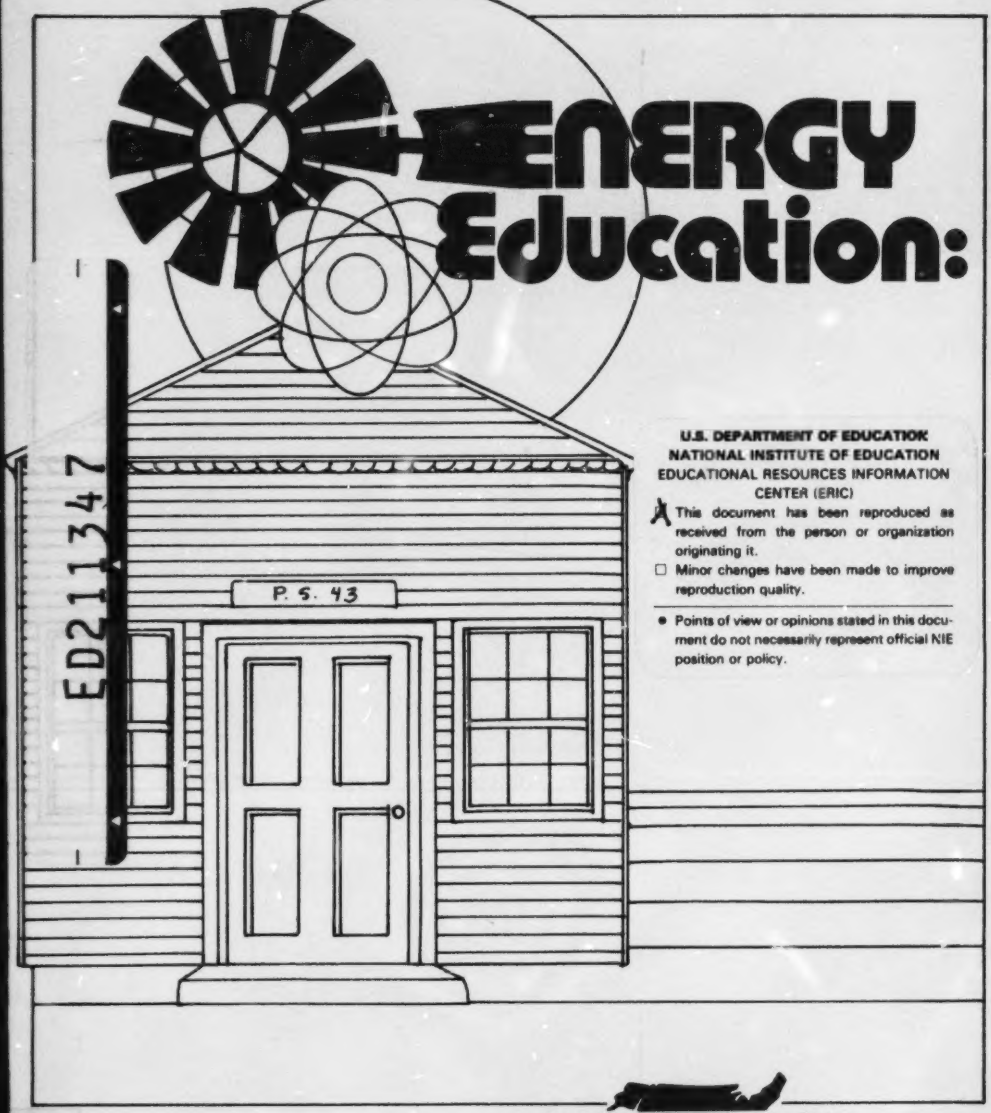

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Education Commission of the States

Why, What and How?

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Energy Education:
Why, What and How?

Report No. I81-1

by Paul C. Bauman
and Edith M. Petrock
State Energy Education Project

Education Improvement Center
Education Programs Division
Education Commission of the States

Robert C. Andringa, Executive Director

October 1981

Additional copies of this report may be obtained from the Education Improvement Center, Education Commission of the States, 1860 Lincoln Street, Suite 300, Denver, Colorado 80295.

Paul C. Bauman is assistant director of the State Energy Education Project at the Education Commission of the States. Edith M. Petrock is the director of the State Energy Education Project. The State Energy Education Project is a component of the Education Improvement Center, directed by Ben Williams.

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Introduction

Energy Education. Why, What and How has been written in order to explain the importance of energy education, describe the content of and rationale for a comprehensive energy education program and provide suggestions for implementing energy education programs at minimal cost. The publication is directed to state-level education policymakers (governors, legislators, chief state school officers, state board of education members, state energy office directors); local-level education policymakers (superintendents, building administrators, local school board members); members of education, political and consumer organizations; representatives of business and industry; and program implementers, including teachers, who are concerned with preparing students and citizens to understand the complex, ever-changing energy situation.

During an era when policymakers must make difficult decisions about essential and nonessential curricular topics, political and education officials and program implementers can benefit from a discussion of energy issues and a consideration of the objectives of a comprehensive energy education program, including strategies for implementation. This document is designed to assist such persons understand why energy education is important and how it can fit into virtually any curricular structure. It does not attempt to provide specific answers or solutions to the many energy-related questions facing society. Instead, it suggests how these important issues can be approached in an objective learning environment. Readers are also invited to use the companion document, *Energy Education: A Policy Development Handbook*, which was developed to help formulate appropriate and useful energy education policies.

This document is divided into three major sections. The first section, "Why Is Energy Education Important?" provides background data on energy issues. The second section, "What Are the Objectives of a Comprehensive Energy Education Program?"

describes six fundamental objectives of energy education and provides a rationale for each. The third section, "How Can Energy Education Be Implemented Effectively?" provides several guidelines for state and local action, stressing low-cost alternatives. The Appendix identifies selected sources of information that may be useful in developing and implementing energy education programs.

Energy Education: Why, What and How has been prepared by the State Energy Education Project at the Education Commission of the States. The project, funded through Grant Number DE-FG05-80IR10903 from the U.S. Department of Energy, provides assistance to states in developing and implementing energy education policies and programs. The State Energy Education Task Force, chaired by the Honorable Richard D. Lamm, governor of Colorado, has guided staff in carrying out project activities and has assisted in the development of this publication. (Task force members and alternates are listed on the inside covers.)

I. Why Is Energy Education Important?

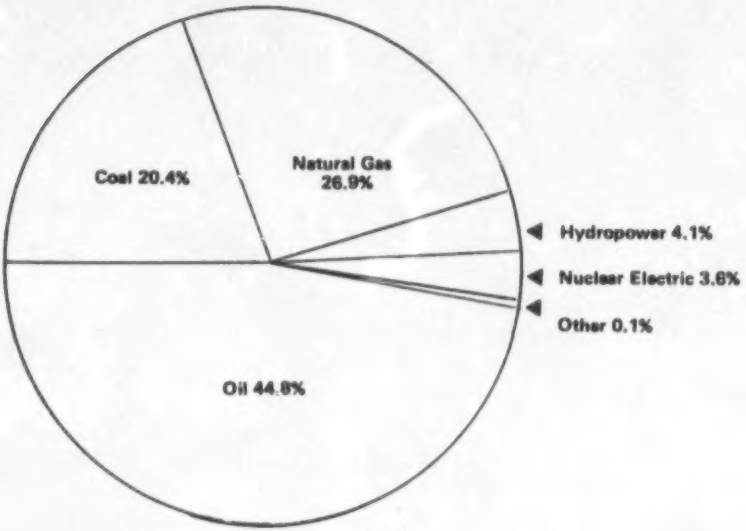
The physical well-being of mankind is affected by society's response to the challenge of providing sufficient energy to satisfy basic human needs without unduly harming the environment. It is important that people understand the energy challenge so that they may be able to consider and help develop responsible alternatives. Education plays an important role in preparing students and citizens to participate in the decisionmaking process and to adapt to changing energy-use patterns.

The desire to improve technological convenience has been a natural response to living in the industrial age. However, it has created a society with escalating demands for large quantities of high-quality energy fuels. Two of these fuels, petroleum and natural gas, were used to satisfy over 70 percent of the total U.S. energy demand in the late 1970s. Yet these two fuels represent only 8 percent of the total domestic proven reserves of all fossil fuels. (Coal accounts for 80 percent, and shale oil accounts for 12 percent of proven domestic reserves.) This has resulted in a heavy dependence on foreign petroleum as a primary energy source.

Figure 1 illustrates the U.S. consumption of energy, by fuel type, for 1980. Figure 2 indicates how that energy was consumed by energy-use sector.

Prior to the 1973 OPEC (Organization of Petroleum Exporting Countries) oil embargo, decisions about the development and utilization of energy sources generally were made in the economic marketplace based on the assumption of plentiful, inexpensive fossil fuels. Little thought was given to national or international supply limitations of those fuels. The increasing national demand for petroleum outstripped domestic supply in the early 1970s, causing a heavy U.S. reliance on imported oil. This dependence has significantly affected the U.S. international balance of trade, contributing to inflation at home and influencing military policy and stability in the Middle East. These historical trends and recent

Figure 1. 1980 U.S. Consumption of Energy by Fuel Type



Total consumption = 76.2 quads* per year
(Source: U.S. Department of Energy, Energy Information Administration, 1981)

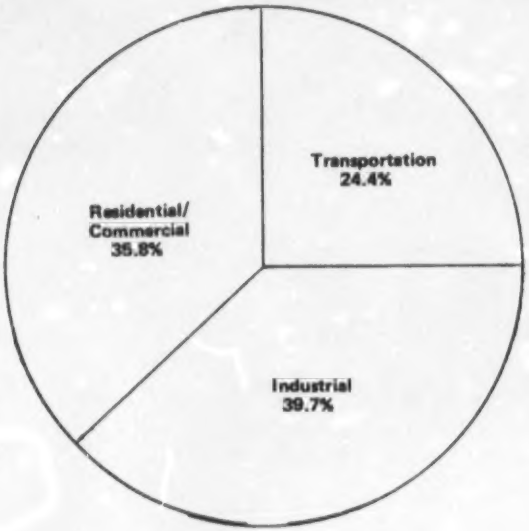
*One quad is one quadrillion (10^{15}) BTU's. One BTU (British thermal unit) is the amount of heat necessary to raise the temperature of 1 lb. of water 1° Fahrenheit.

international developments illustrate the integral relationships among energy supply and demand, national security and the international economic system.

In the past, transitions from one principal energy source to another were motivated primarily by the desire for a higher standard of living and made possible by technological advances. However, today the need for another transition stems from the diminishing domestic reserves of petroleum and from a need to decrease our national vulnerability to the whims of foreign suppliers.

Indeed, the next transition has already begun. Yet many knowledgeable and responsible individuals cannot agree on an appropriate energy mix for the new era. In fact, there is even a lack of agreement as to whether any transition is required. Citizens are

Figure 2. Total U.S. Energy Consumption by End Use Sector for 1980



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bombarded by the media almost daily with conflicting reports of dwindling reserves of petroleum and projections of new reserves from undeveloped fields. Scientists and advocates extoll the virtues of obtaining oil from shale, gaseous and liquid fuels from coal, heat and electricity from the sun, power from the wind, alcohol fuels from crops, energy from nuclear fission and heat from hot, dry rock deep within the earth's crust. People read about the 21st century commercialization of nuclear fusion and hydrogen fuel – "the fire in the water." They hear projections of production and cost for nuclear and solar technologies – no two of which seem to be the same – from public and private agencies and from special interest groups. Many wonder what happened to Project Independence and to the "energy crisis" which was once considered "the moral equivalent of war." They wonder whether our domestic energy problems are real or contrived and whether it

is still necessary to conserve energy in light of the different perspective of a new Administration.

Given the extent to which available information is inconsistent – and often contradictory – no one should wonder that a 1980 U.S. Department of Energy opinion poll determined that 65 percent of the respondents considered the energy problem not serious. Other recent polls and national studies have indicated a lack of knowledge about energy sources and supplies, the extent of U.S. reliance on oil imports and the viability of alternative technologies.[1] In short, the U.S. may be in the middle of an energy transition, apparently without a clear goal in mind, and its citizens appear ill-prepared to assist in determining appropriate objectives and strategies.

In order to avoid chaos and to facilitate public understanding and cooperation in whatever changes lie ahead, the active involvement and participation of state, federal and local policymakers; the business sector; the energy industry and lay citizens are required, particularly since energy-related change will affect virtually all Americans. Public knowledge of the availability of energy sources, the applicability of different sources to specific tasks, the developmental lead times for various resources and technologies, associated economic and environmental costs and attendant societal effects is prerequisite to informed decisionmaking and future planning. Therefore, although no definite solutions are obvious at this time, educators must contribute to the eventual resolution of the energy problem by presenting the issues fairly in the classroom.

Ironically, increasing energy costs are eroding school district budgets and, consequently, the financial capability of the schools to develop the comprehensive energy education programs that are needed. Furthermore, since energy education programs in most states have been supported largely with federal money, there has been a lesser incentive for financial commitment to energy education by state and local governments. However, changing federal policy and budget priorities have reduced federal support

[1] National Assessment of Educational Progress, *Energy Knowledge and Attitudes*, Report No. 08-E-01 (Denver: Education Commission of the States, December 1978), p. 27; Daniel Yergin and Robert Stobaugh, eds., *Energy Future*, (New York: Ballantine, 1980), pp. 271, 454.

for energy education severely. Unless state and local governments accept the fiscal responsibility for sustaining these programs, a loss of continuity and efficiency in administering the nation's energy education effort will surely result.

II. What Are the Objectives of a Comprehensive Energy Education Program?

The goal of energy education is to enable people to understand basic energy concepts in order to make informed decisions regarding energy development, utilization and conservation, knowing about options and their trade-offs. The following six objectives are components of a comprehensive energy education program designed to meet this goal.

Objective 1. To Enable People to Understand the Nature and Importance of Energy

Rationale

A knowledge of the basics of energy is a prerequisite for wise decisionmaking. Principles of energy efficiency, based on the laws of thermodynamics, can be applied to daily living only if those principles are adequately understood. Energy does not seem to be an important topic until people understand why energy is essential to their daily lives, realize the variety of energy sources, and learn of the application of specific sources to various tasks. It is only after grasping these basic facts that U.S. citizens can fully appreciate the ramifications of using imported petroleum as the driving force of the national economy.

Content Description

The fundamentals of energy include its different states and forms. The two states of energy are potential – at rest – and kinetic – in action. Heat, light and motion are forms of kinetic energy, while electrical, chemical and mechanical are forms of potential energy.

Understanding the nature and importance of energy requires an awareness of different energy sources (including nuclear, solar,

hydro and fossil fuels), as well as the ways in which individuals and society depend upon energy for such purposes as transportation, manufacturing, heating and cooling.

A basic understanding of energy also includes energy flows: how energy is extracted, refined, distributed and used. An example is the natural gas system that involves wells, treatment plants, pipelines and a variety of final uses, such as space and water heating.

Objective 2. To Provide Information About Changing Supply and Demand Factors for Various Energy Sources

Rationale

Historically, supply-demand economics has been used as a basic tool for decisionmaking in our industrial society. While government-imposed pricing regulations have affected the operation of the economic marketplace, nevertheless, world energy producers have usually been able to meet consumer demand at prevailing prices. New information concerning possible limits of domestic supplies of traditional energy sources raises serious questions about producers' ability to continue meeting energy demands. How long will fossil fuel resources last at present rates of consumption? What mix of energy sources will supply energy demand in 10 years, or 20 years? To what extent can society depend on renewable energy sources? The answers to these questions must be based on the best available information about present and projected energy supplies, taking into consideration anticipated demands from all use sectors. Public knowledge of the applicability of various energy sources to specific tasks, developmental lead times and different supply and demand factors are prerequisites to future planning and maximum citizen involvement.

Content Description

Each energy source is characterized by its amount, its ability to be converted to a useful form and the demand for that particular energy source at different price levels. The relative cost and usefulness of various energy sources are major factors in determining their actual supply and demand at any given time.

Historically, societies have switched from one primary energy source to another, such as during the early 20th century when oil replaced coal as the nation's primary fuel due to the increased demand for a liquid fuel and because oil was in abundant supply. Now that the supply of oil is generally recognized to be limited, additional energy is being sought from alternate sources through several new technologies and methods of conversion. Simultaneously, the viability of traditional sources, including coal, is being re-evaluated.

World demand for energy has been increasing exponentially due to growth in both population and energy consumption per capita. (From 1890 to 1970 world consumption of crude oil grew at a rate of 7.04 percent a year. At this growth rate, total demand for crude oil doubled approximately every 9.8 years.[2]) While conservation has helped limit the increase in per capita energy consumption in the United States, annual energy demand can be expected to grow, although probably at a lesser rate. The Public Discussion Package for the Third National Energy Plan stated that, "As a result [of higher oil prices], overall energy consumption is projected to grow at slightly more than one percent per year from 1979 to 1990."[3] While experts disagree over the size of various energy reserves and over the amount of time required to consume them, they do agree that the supply of fossil fuels, our major traditional energy source, is finite. Therefore, meeting increasing demands poses serious challenges for the future.

Objective 3. To Prepare People to Consider the Local, Regional, National and International Implications of Different Energy Sources

Rationale

Students and other citizens must know about the various impacts of alternate energy sources in order to play a meaningful role in

[2] Albert A. Bartlett, "Forgotten Fundamentals of the Energy Crisis," *Journal of Geological Education,* 1980, vol. 28, p. 8.

[3] U.S. Department of Energy, "Public Discussion Package for the Third National Energy Plan: Notice of Public Hearings and Staff Working Paper," March 1981, p. 5.

determining energy policy through the political process. Possessing sufficient factual information, they can be encouraged to participate actively to ensure that their views and concerns are represented adequately.

Content Description

The extraction, production, distribution and utilization of different energy sources have differing economic, political, social, environmental and technological impacts. These impacts vary according to geographic region, economic sector, and socio-economic characteristics of energy users.

Economic impact. The price of energy and the quantity consumed determine its total cost. While energy prices are dependent on extraction, processing and distribution costs and on state and federal pricing regulations, they are also sensitive to changes in demand. Total costs for space heating and cooling are generally higher in regions with extreme high or low temperature conditions. For example, northern regions require increased energy supplies (predominantly natural gas and heating oil) during the colder winter season, and the Sun Belt needs more electrical energy for air conditioning during the summer season. Many western states produce more energy than they use and primarily rely on natural gas for home heating. In contrast, the northeastern states use more energy than they produce and rely on petroleum products, imported from other regions and other nations, for home heating. Hence, the absolute amount of energy consumed, its source and its price vary seasonally and geographically.

Energy costs affect the price of goods and services that require energy for production and/or distribution. Therefore, rising energy costs have had a significant inflationary impact on the world economy in recent years. And because of differences in the amount and type of energy used by various economic sectors (government, business, industry and households), the economic impact of changes in energy price and availability has not been uniform.

The existence of international discrepancies between energy availability and consumption is an important factor in the international economic picture, affecting the balance of trade among energy exporting nations and energy importing nations.

And, a nation's economic relationships with other countries influence the strength of domestic industries and the relative costs of goods and services to its citizens.

Political impact. Varying degrees of government control and taxation are associated with different natural resources and technologies. Federal, state and local government all have been involved in regulating cost, production processes and prices through such means as environmental impact standards, severance taxes, requirements for community service assistance, location incentives and pricing regulations.

There are also major international and domestic political factors associated with the use of energy. For example, the use of imported petroleum significantly affects the international balance of power and national security. Domestically, the mining and distribution of coal and other fossil fuels have raised issues of regional inequities in the availability and price of energy, which underlie the current debate over state-imposed severance taxes. Another issue is federal policy governing the development of energy sources on public lands.

Social impact. Lifestyle is closely related to energy production and usage patterns. Social impacts vary according to one's geographic location and economic characteristics. The physical structure of industrialized society – its sprawling suburbs, shopping centers and interstate highway systems – resulted in part from the mobility offered by the automobile, which is almost totally dependent on one specific energy source, petroleum. As petroleum prices escalate, mobility is becoming more dependent upon one's ability to pay. Even people who do not rely upon automotive mobility are indirectly affected by petroleum prices and availability in the form of price escalation and/or relative scarcity of a wide range of products and services that use petroleum for production and/or distribution.

The escalating price of heating fuels raises additional social issues. The most severe of these is the problem of equitable treatment for the poor and elderly who lack the discretionary funds to pay higher costs.

Proximity to resource extraction and processing causes additional

social benefits and costs. For example, the new demand for great amounts of western coal creates large industries with related jobs – and accompanying demands for housing, schools, community and social services. And because families moving to energy boom towns frequently experience negative symptoms of dislocation, the requirements for community and social services can be both acute and expensive.

Environmental impact. Different methods of energy extraction, production, distribution and use affect the environment in varying ways and degrees. Such impacts tend to generate considerable public controversy when long-term effects are difficult to assess and when large expenditures are necessary to mitigate adverse impacts. Obvious examples include strip mines, oil and gas pipelines and nuclear waste disposal. The potential "greenhouse effect" from accumulating hydrocarbon waste is currently the subject of extensive scientific inquiry.

Technological impact. The technologies needed to utilize different energy sources efficiently are at various stages of research and development. While the burning of wood or coal is a simple and inexpensive technology, making the breeder reactor a viable alternative requires extensive – and expensive – government-sponsored research. Will the most productive and cost-effective solar alternatives be the photovoltaic cell or the heating and circulation of water or air? How will further development in the use of geothermal energy affect areas where that source is available? And, will inventors find a satisfactory substitute for the gasoline-powered automobile? The future viability of our alternative energy sources depends upon the answers to these and other questions being asked in the public and private sectors.

Objective 4. To Provide Information About Conservation

Rationale

The meaning of energy conservation and its importance must be understood before we can achieve its inherent objectives. Conservation is an essential component of our nation's energy policy and, when understood as the avoidance of waste, it is basic to our national philosophy. Yet there are many questions and concerns

about the best ways to motivate the public to conserve energy. For example, should the federal government promote conservation through tax incentives and interest-free loans? If conservation is driven by economic factors alone, what will happen to the poor and elderly who may not be able to pay for conservation measures, regardless of payback period? And, because schools cannot pass higher energy costs to their clientele, what will happen to school budgets? If we conserve through large-scale recycling programs, how will employment be affected? Should the government force fuel conservation through regulation of automobile efficiency and insulation standards? Energy conservation included in an education program can be viewed as an opportunity to consider, but not necessarily answer, these important policy questions.

Content Description

Conservation is the wise and efficient use of energy. Although the extent to which conservation can reduce total energy demand is open to question, curbing demand can help limit rising energy expenditures and prolong the life of finite reserves. However, whether or not actual cost savings can be realized depends upon how much energy is saved and how much energy prices escalate. Teaching about conservation requires discussing its purposes and explaining practical techniques that can be applied at school, at home or in the community.

Objective 5. To Prepare People to Make Personal and Societal Decisions Related to Energy Supply Disruptions

Rationale

Based on knowledge of the likelihood of energy supply disruptions, practical contingency plans on both the personal and societal levels should be developed as valuable emergency strategies. An understanding of the implications of energy supply curtailments can enable individuals to respond more effectively and efficiently should it become necessary to use such plans.

Preparing people to make decisions in the event of a community, state or national disruption poses several important questions: What might be the impacts of different potential emergencies?

Which energy supplies are most vulnerable to interruption? What activities should be curtailed? Should all energy-use sectors be asked to reduce consumption to the same degree? Is closing schools an effective strategy to help meet the community shortfall or are there better options? Developing wise answers to these strategic questions requires an informed citizenry.

Content Description

According to a recent report of the U.S. Senate Committee on Energy and National Resources, "A major oil supply disruption within the 1980s is considered a likely event."[4] Curtailments of conventional energy supplies (natural gas, fuel oil, gasoline and electricity) on regional or local bases have occurred in the past and could recur with little warning. Yet the production and distribution of essential goods and services depend upon a consistent energy supply. The extent to which supply disruptions affect energy consumers is contingent upon the amount and type of energy used and the extent and nature of the disruption. For example, a shortfall in the supply of imported crude oil would have greater implications for regions and industries highly dependent on oil as a primary energy source than for those dependent on a domestic energy source such as coal.

Objective 6. To Prepare People for Energy-Related Careers and To Become Energy Conscious in Other Career Fields

Rationale

One of the traditional roles of education is to prepare individuals to become productive, self-supporting members of society, able to choose among career options and possessing the requisite knowledge and skills for the selected vocation. Among these career options, conventional and developing energy technologies should not be overlooked. For example, there is an increased demand for individuals possessing vocational/technical skills in such fields as solar heating and cooling and energy management. Meanwhile, established energy careers, such a petroleum geology, continue to provide opportunities for people with the necessary training. An

[4] "Executive Summary of the Geopolitics of Oil," *Science Magazine*, vol. 210, December 1980, pp. 1324-1327.

awareness of energy and energy conservation must also be encouraged in persons entering or engaged in existing fields, including the building trades and other businesses and industries attempting to cut energy costs while maintaining and/or increasing productivity.

Content Description

Continuing developments in energy use and production have created new career opportunities. Large-scale use of alternative energy sources and conservation technologies should create jobs in previously nonexistent fields, such as residential energy auditing. Due primarily to rapidly increasing energy costs, conservation skills are being sought by energy-intensive businesses and industries. The research and development of both new and existing energy sources, such as nuclear and solar, present additional career opportunities for today's students.

III. How Can Energy Education Programs Be Implemented Effectively?

This section suggests guidelines for program developers interested either in establishing an energy education program or in modifying or adapting an existing program to emphasize a consideration of energy issues. The implementation strategies in this section emphasize those that require minimal additional costs and maximal use of existing education resources.

Guideline 1. Cost-Effectiveness

Limited federal and state support for program development combined with school districts' tight budgets necessitates the use of cost-saving methods and techniques whenever possible. Therefore, an energy education program must be developed as economically as possible while maintaining quality standards. Existing resources, information and expertise should be located and used whenever they are relevant and appropriate, thus avoiding duplication of effort and unnecessary expenditures. In most states there are agencies that may have developed or collected energy education materials. These include state education agencies, state energy offices, public information branches of transportation or highway departments, economic planning offices, public utility commissions and legislative service offices. Other possible sources of help are state colleges and universities, vocational/technical institutes and business and industry associations.

There are a number of potential energy education resources at the local school district or community level. Many energy and utility companies provide free materials, guest speakers, in-kind contributions and/or funding for such things as teacher inservice programs and student field trips. Community colleges, public libraries, civic groups, city and county governments and other community-based

public interest groups often can provide assistance in locating human and material resources.

A school or school district energy committee, composed of teachers, students, parents, administrators, industry leaders and other community representatives, can be formed to contribute local talents and interests to both energy education programs and energy management programs designed to avoid a portion of the school's rapidly increasing energy bills. This committee can undertake the responsibility of reviewing exemplary program models and materials that could then be modified, if necessary, and used to meet the identified needs of local students and facilities.

Free materials are available from several national organizations and federal agencies, as listed in the Appendix. Energy information is also obtainable from federal sources other than those directly responsible for energy or education programs. For example, the Department of Agriculture's Cooperative Extension Service can provide useful information in such areas as residential and small business energy conservation, home economics and transportation fuel efficiency. Other departments involved in energy include the Department of State (information on global implications of energy use and production, location and amount of energy resources), the Environmental Protection Agency (environmental impacts resulting from the extraction and utilization of various energy sources and related federal standards), the Department of Transportation (transportation fuel efficiency), and the Community Services Administration (energy conservation for the poor and elderly).

Finally, the adoption of a statewide or local school district policy supporting energy education may provide teachers, administrators and students with the incentive to investigate energy issues in existing units of study.

Guideline 2. Curricular Considerations

There are different strategies for including energy education in an often overburdened curriculum. A comprehensive energy education program should reflect an awareness of the interdisciplinary nature of energy. Teachers can examine existing subject areas to

find appropriate opportunities for discussing energy as a basic factor in several, if not all, subjects. For example, in history, students can study about the discovery of the internal combustion engine and the impact of automotive production in the American labor movement; in English, energy policy issues can be essay subjects; in mathematics, exponential curves can show changing energy demand; in social studies, the relationships among energy exporting and importing nations can be examined; and in economics, the impact of petroleum prices on the national rate of inflation can be analyzed.

Energy is an excellent theme around which to build an interdisciplinary curriculum. In planning interdisciplinary courses, cooperating subject-area teachers should seek opportunities to pursue the ways in which the content of their particular disciplines relates to core energy issues. In lieu of entire multidisciplinary courses, enrichment activities or joint discussions with other classes can be implemented.

In order to meet the identified objectives of an energy education program and to achieve both continuity and a graduated approach to more abstract energy concepts, attention must be paid to scope (the breadth of content) and sequence (the logical ordering or building of concepts and information). The first step in designing a comprehensive energy education program is to determine what concepts and information are to be presented during which grades and within which academic disciplines. Then modules, or units, can be located or developed that present the desired content at the appropriate degree of difficulty.

Historically, most energy education programs have been designed for integration into the existing curriculum. Easily integrable modules provide educators with a relatively simple way to incorporate energy concepts into their classes. This process is called *infusion.* (With teacher assistance, the National Science Teachers Association's Project for an Energy Enriched Curriculum has developed such units, as noted in the Appendix.)

However, it may not even be necessary to infuse existing courses with energy concepts. Instead, it may be sufficient merely to give more emphasis to energy-related parts already present in current curricular components. This approach is most possible in the fields of science and social studies.

Special courses dealing with energy can be developed, providing an opportunity to study energy use and production in greater detail. For example, solar energy, nuclear energy, conservation techniques, energy management and other single topics have been taught as special or elective courses. Vocational education at high school and college levels is an area where specialized programs have been established to meet an increasing demand for energy-related job skills.

Guideline 3. Objectivity

In order to be truly valuable and useful, an energy education program must be objective and impartial. It must be designed to provide factual information enabling people to draw their own conclusions and to make more informed decisions regarding energy questions and issues. No single energy source should be favored over others, just as no particular political party should be favored in a political science class. If information is presented with a bias toward a certain energy source or production and distribution methodology, an attempt should be made to recognize opposing opinions. When considering controversial energy issues, program developers should establish a balanced approach with viewpoints from several perspectives, thus allowing the education process to promote inquiry and to stimulate an appreciation for alternative solutions.

In developing and selecting programs, it is important to include a coalition of teachers, school administrators, industry representatives, parents, students and community leaders, perhaps in the form of a school or school district energy committee, as described above under "cost-effectiveness." In this way a greater diversity of technical and policy options can be considered, and the concerns of individuals and organizations having different viewpoints will not be overlooked.

When contemplating alternative energy use patterns, the principle of objectivity demands that students weigh the interrelated social, economic, political, technological and environmental implications of each of those patterns.

Guideline 4. Relevance

Energy is a relevant topic because it pervades most aspects of daily living in an industrialized society. A personal understanding of the importance of energy may be achieved by focusing on local, state and/or regional energy concerns. Students can examine how energy is supplied to their community and how it is being used. What are the local and state energy-use sectors and how does their consumption compare with other states or regions? How are these particular energy supply and demand patterns affecting local political, economic and environmental conditions? Raising these questions will often present students with many learning opportunities in existing subject areas, such as geography, science, mathematics, political science and economics. New and emerging energy-use technologies, as well as major changes in national energy policy, necessitate revisions in teaching materials and course content whenever necessary. An ongoing process of evaluation and refinement is necessary to assure the continuing viability of energy education programs.

Guideline 5. Teacher Preparation and Participation

The involvement of teachers in the development of a workable energy education program is essential if energy concerns are to be dealt with in the schools. Teacher colleges and university departments of education can initiate an awareness of the need to integrate energy topics into different areas of specialization. Proceedings from the Second Annual Practitioners Conference on Energy Education, convened in 1979 by the National Science Teachers Association in cooperation with the Illinois Board of Education, the Illinois Institute of Natural Resources, the Edison Electric Institute and the Shell Company Foundation, stressed this point:

> Teachers must be energy literate if they are to enthusiastically and effectively teach about energy. Therefore, inservice training in energy education is crucial and should be instituted for teachers of all grades and disciplines. An ideal teacher inservice model should include awareness, concepts, application, implementation and evaluation of technical information and energy education materials and methods. Teachers should be familiarized with available energy education

materials and methods for local curriculum adaptation and/or infusion into their programs.[5]

Teachers representing different disciplines and grade levels can make valuable contributions to the development and formulation of a schoolwide energy education program. Personal involvement in preparing a lesson plan or course outline can impart a sense of enthusiasm. The interest and involvement of teachers is essential to implement an effective energy education program, regardless of the quantity or quality of printed or multimedia materials produced or utilized.

Teacher inservice programs are excellent opportunities for state agencies, colleges and universities to assist local school districts in the development and implementation processes. Coordination and cooperation among local school districts and state agencies are essential for carrying on comprehensive teacher preparation programs at minimal cost.

State education agencies and energy offices, in conjunction with other state agencies, provide support and assistance for teachers in a variety of other ways as well. They can assume a leadership role in initiating a supportive statewide energy education policy, as described in *Energy Education: A Policy Development Handbook.*[6] They can act as conveners or catalysts, providing technical assistance, resources, information and guidance.

While a plethora of human and material resources are available, teachers must learn where and how to find needed assistance. The following Appendix is a tool to begin that process. Entries have been selected that provide free or inexpensive materials on a wide range of topics.

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[5] Helenmarie Hofman and F. Gene Miller, eds., *Second Annual Practitioners Conference on Energy Education Proceedings* (Washington, D.C.: National Science Teachers Association), 1980, p. 12.

[6] Edith M. Petrock, Report No. 142 (Denver: Education Commission of the States, August 1981).

Appendix: Resource Bibliography

The organizations listed and the services they provide are based on the most recent information available (July 1981). Care was taken to present a balance of agencies from the public and private sectors and to include sources of information on specific energy alternatives. Further information on topics of regional or local interest can be obtained from the state and local resources discussed in the previous section.

The following organizations are listed alphabetically and include both government and industry sources that may be useful in the development of energy education programs. This list is not a complete compendium of resources. Instead, only those government agencies, trade associations and other organizations primarily designed to provide energy and education information and assistance have been included.

Alliance to Save Energy

The Alliance to Save Energy is a private, nonprofit, bipartisan organization. It was established to promote energy conservation and to develop and implement public education and technology interchange programs designed to reduce energy waste nationwide.

The Alliance is involved in several education-related activities, including conducting research on energy conservation; developing and distributing newsletters, books, pamphlets and films for television and education groups; and producing materials for newspapers, magazines and radio. The Alliance also provides speakers and panelists for conventions, conferences and seminars. For further information contact

Alliance to Save Energy
1925 K Street NW, Suite 507
Washington, D.C. 20006
(202) 857-0666

American Gas Association (AGA)

AGA has an Educational Programs Department that produces free materials for teachers that are available through local natural gas companies. A free

catalog of printed and audiovisual materials appropriate for K-12 students is available from AGA.

For more information contact a local natural gas company or the following:

Educational Services
American Gas Association
1515 Wilson Blvd.
Arlington, Virginia 22209
(703) 841-8664

Atomic Industrial Forum (AIF)

AIF is a nonprofit international management association representing organizations interested and involved in commercial nuclear energy. Teachers may order up to three copies of reprints of articles related to nuclear energy, sets of AIF brochures and a "Teacher Packet on Nuclear Power" at no cost. For further information, contact

Education Services
Atomic Industrial Forum, Inc.
7101 Wisconsin Avenue
Washington, D.C. 20014
(301) 654-9260

The American Petroleum Institute (API)

API is a trade association representing over 300 oil companies. It is designed to disseminate information about virtually every aspect of the petroleum industry: exploration, production, transportation, refining and marketing. API recently published a second edition of *Looking For Energy?*, a catalog of information resources for energy educators from both the private and public sectors. Free copies of the catalog and further information about API can be obtained from

American Petroleum Institute
Publications and Distribution Section
2101 L Street NW
Washington, D.C. 20037
(202) 457-7160

Conservation and Renewable Energy Inquiry and Referral Service (CAREIRS)

CAREIRS is responsible for providing information and referral services to the general public on all renewable forms of energy, including solar, wind, hydro, photovoltaics, bioconversion and conservation. CAREIRS assumed the responsibility of the Solar Energy Research Institute (SERI) in Golden, Colo., for public information dissemination about renewable energy. (As a result of recent policy changes, SERI will only provide information about their research and development activities to specialists and technicians involved in similar research.)

CAREIRS is the successor to the National Solar Heating and Cooling Information Center, originally a contractor for the U.S. Department of Housing and Urban Development. For further information contact

Conservation and Renewable Energy
Inquiry and Referral Service
P.O. Box 8900
Silver Spring, Maryland 20907
1-800-523-2929 (toll free number)

The Energy and Education Action Center (EEAC)

EEAC was established by the U.S. Department of Education to promote all phases of energy education and school conservation activities. It draws upon federal, state and local resources to assist educators in obtaining technical advice, information and other assistance.

EEAC serves as a clearinghouse and has a national information hotline, providing information on conservation, school energy costs, curricula, vocational and professional training. For further information contact

Energy and Education Action Center
U.S. Department of Education
1651 Donohoe Bldg.
400 Maryland Avenue SW
Washington, D.C. 20202
(202) 472-7777

Edison Electric Institute (EEI)

EEI is the trade association of the investor-owned electric companies. Approximately 200 organizations, generating nearly 80 percent of all the electricity of the United States, are members of EEI. EEI is recognized as the central source of information on electric energy and the electric utility industry in the United States.

EEI distributes a free catalog with abstracts of general energy books, consumer materials, technical books and references. Multimedia instruction kits produced by EEI can be purchased through local member companies. The Institute's address and phone number are listed below:

Educational Services
Edison Electric Institute
1111 19th Street NW
Washington, D.C. 20036
(202) 826-7400

Energy and Man's Environment (EME)

EME is a nonprofit education corporation partially supported by business, industry, state and local education agencies and civic organizations. EME works with educators in developing energy education programs designed to

achieve energy literacy. EME has 15 state consortium members, with state coordinators and planning committees who work to implement programs for their respective states. For further information contact

Energy and Man's Environment
7874 S.W. Nimbus Avenue
Beaverton, Oregon 97005
(503) 641-9043

Educational Resources Information Center (ERIC)

ERIC is a nationwide network of 16 information clearinghouses under the direction of the National Institute of Education (NIE). These centers collect documents in different areas of education, screen them for relevance and interest, abstract and index those selected and add them to the ERIC data base. The ERIC data base can be accessed by subscribing to any of several computer systems, such as the System Development Corporation's ORBIT or Lockheed's DIALOG Information Services data base. ERIC additions to the inventory are announced every month in *Resources in Education* (RIE) for documents, and *Current Index to Journals in Education* (CIJE) for journal articles, which can be obtained from any ERIC clearinghouse. Any agency, institution or library having a computerized search service capability can provide assistance in accessing ERIC documents. The primary ERIC clearinghouse for energy information is the ERIC Clearinghouse for Science, Mathematics and Environmental Education. Its address is

ERIC Clearinghouse for Science, Mathematics
and Environmental Education
Ohio State University
1200 Chambers Road, 3rd Floor
Columbus, Ohio 43212
(614) 422-6717

For additional ERIC information contact any of the following centers:

Educational Resources Information Center
(Central ERIC)
National Institute of Education
1200 19th Street NW
Washington, D.C. 20208
(202) 254-7934

ERIC Processing and Reference Facility
4833 Rugby Avenue, Suite 303
Bethesda, Maryland 20014
(301) 656-7923

ERIC Document Reproduction Service
P.O. Box 190
Arlington, Virginia 22210
(703) 841-1212

ERIC Clearinghouse for Social
Studies/Social Science Education
855 Broadway
Boulder, Colorado 80302
(303) 492-8434

ERIC Clearinghouse for Educational Management
University of Oregon
Eugene, Oregon 97403
(503) 686-5043

National Coal Association (NCA)

NCA acts as the national clearinghouse for coal information as well as the spokesman and advocate for the coal industry.

NCA produces a variety of publications covering many aspects of the coal industry which can be purchased by non-NCA members. Also available at a small fee is "Discovering Coal," an education program designed for primary grade teachers that explains the significance and use of coal. For further information contact

National Coal Association
1130 17th Street
Washington, D.C. 20036

National Science Teachers Association (NSTA)

Through its Project for an Energy-Enriched Curriculum (PEEC), sponsored by the U.S. Department of Energy, NSTA has produced a series of instruction packets for elementary and secondary schools. Primarily written by social studies and science teachers, these materials are designed for convenient infusion into existing curricula. They feature a wide range of activities that encourage direct student participation while introducing basic energy concepts. PEEC materials are available from the Department of Energy's Technical Information Center. (See page 27.) NSTA also publishes *Energy and Education*, a bimonthly newsletter dedicated to the teaching of energy and science. For more information on NSTA or to subscribe to *Energy and Education* contact

National Science Teachers Association
1742 Connecticut Avenue NW
Washington, D.C. 20009
(202) 328-5840

The National Technical Information Service (NTIS)

NTIS is the central source for public sale of U.S. government-sponsored research and development reports. NTIS energy education publications include a free catalog of energy-related reports, *Energy Information Referral Directory*, and *Energy Education Materials Inventory*. (The latter is a

comprehensive bibliography of materials, including audiovisuals, books, instruction guides and activities cross-referenced by grade level and subject matter.) For further information contact

The National Technical Information Service
U.S. Department of Commerce
5285 Port Royale Road
Springfield, Virginia 22161
(703) 487-4600

Nuclear Information and Resource Service (NIRS)

Nuclear Information and Resource Service (NIRS) is a national clearinghouse and networking center for people concerned about nuclear issues. NIRS offers *Groundswell*, a bimonthly newsletter covering the latest industry, government and citizen action on nuclear issues. NIRS is in the process of compiling a teacher's guide to energy, including an overview of different energy topics as well as resource listings, bibliography and materials adoptable for classroom use. For more information, contact

Nuclear Information and Resource Center
1536 Sixteenth Street NW
Washington, D.C. 20036
(202) 483-0045

Oak Ridge Associated Universities (ORAU)

ORAU is a private, nonprofit association of 50 colleges and universities. It works with the U.S. Department of Energy, other private and government organizations and its member institutions to help solve societal problems relating to energy, health and the environment.

The Energy Education Division presents live education programs dealing with various aspects of energy to high school students and civic clubs using teacher-demonstrators with general and specific-subject training.

In addition, ORAU offers energy conservation management training and has a team of energy auditors for schools and hospitals who also do comparative studies for national and state energy conservation programs. For details contact

Energy Education Division
Oak Ridge Associated Universities
P.O. Box 117
Oak Ridge, Tennessee 37830
(615) 576-3031

Schoolhouse Energy Efficiency Demonstration (SEED)

SEED is a public service program developed by Tenneco, Inc. to assist schools in reducing the impact of rising energy costs through effective energy management programs and low-cost solutions to energy inefficiencies.

SEED materials available free of charge include *The Fourth R*, a film describing schoolhouse energy audits; *The Fourth R: Resourcefulness in School Energy Conservation*, a booklet accompanying the film, describing school energy problems and appropriate solutions; *Something Special From SEED*, a classroom guide and technical manual designed to assist "nontechnical" persons in conducting an energy audit; and *Something Special for Teachers*, a schoolhouse energy teaching program designed to assist teachers in using the school facility and existing curricula to teach about energy. For information write to

Public Affairs Department
Tenneco, Inc.
P.O. Box 2511
Houston, Texas 77001

Technical Information Center, (TIC), U.S. Department of Energy

TIC maintains an energy data base containing references to books, conferences and reports. TIC's education offerings include pamphlets, brochures, posters and special packets, such as the PEEC materials described under the National Science Teachers Association heading on page 25. At present, up to 50 copies of the PEEC instruction materials are available by individual title, free of charge, while supplies last. TIC also maintains an extensive film library covering the whole range of Department of Energy information. For information or materials contact

Department of Energy
Technical Information Center
Box 62
Oak Ridge, Tennessee 37830
(615) 576-1308

ECS Energy Education Task Force (cont.)

Alternates and Observers

Charles Bottinelli
President, Energy Information Associates, Inc.
Denver, Colorado

Robert Brown
Director, Energy Extension Service
Colorado Office of Energy Conservation
Denver, Colorado

Homer Elseroad
Education Consultant
Ijamsville, Maryland

Neal McCormick
Senior Consultant, Facilities and Energy
Colorado Department of Education
Denver, Colorado

Harry Meek
Manager, Energy Assistance Office
Ohio Department of Education
Columbus, Ohio

Pat Pascoe
Commissioner, Education Commission of the States
Denver, Colorado

Robert Sampson
Assistant Manager of Program Planning and Development
Illinois State Board of Education
Springfield, Illinois

Buie Seawell
Governor's Legislative Liaison
State of Colorado
Denver, Colorado

The Honorable John Sessions
State Representative
Idaho State Legislature
Boise, Idaho

Margaret St. Clair
Deputy Secretary of Energy
Executive Office of Energy Resources
Boston, Massachusetts

C. Richard Tillis
Director, Office of Energy and Environmental Education
Florida Department of Education
Tallahassee, Florida

Project Officer

Donald Duggan
Division of University and Industry Programs
Office of Energy Research
U.S. Department of Energy
Washington, D.C.

The Education Commission of the States is a nonprofit organization formed by interstate compact in 1966. Forty-eight states, American Samoa, Puerto Rico and the Virgin Islands are now members. Its goal is to further a working relationship among governors, state legislators and educators for the improvement of education. This report is an outcome of one of many commission undertakings at all levels of education. The commission offices are located at Suite 300, 1860 Lincoln Street, Denver, Colorado 80295.

It is the policy of the Education Commission of the States to take affirmative action to prevent discrimination in its policies, programs and employment practices.